

10.1 Growth and Cell Reproduction

Growth is a characteristic of all living things. You started out as a single cell. That cell quickly divided into two cells. Two cells became four and four became eight. Eventually, you grew into an organism made of *billions* of cells. As you continue to grow, your cells will divide to make more and more cells. Also, your cells divide to replace cells that have died, or to repair damaged tissues. Each new cell contains an exact copy of the DNA that's found in all of your body cells. How do cells divide to make exact copies of themselves?

What is cell division?

Cells reproduce by dividing Most of the cells in your body reproduce by dividing into two cells called *daughter cells*. Each daughter cell contains an exact copy of the DNA found in the original (parent) cell (Figure 10.1). The process of one cell dividing into two daughter cells is called **cell division**. Most cells reproduce by cell division.

The process of one cell dividing into two daughter cells is called cell division. Each daughter cell contains an exact copy of the DNA found in the parent cell.

Cell division in prokaryotic cells As you learned earlier, prokaryotic cells like bacteria do not have a nucleus. Their DNA is found bunched up in the cytoplasm. Because of this, their cell division is simpler than the division of eukaryotic cells. Bacteria reproduce by splitting in two. Each daughter cell contains one copy of the DNA from the original cell.



VOCABULARY

cell division - the process of one cell dividing into two daughter cells.

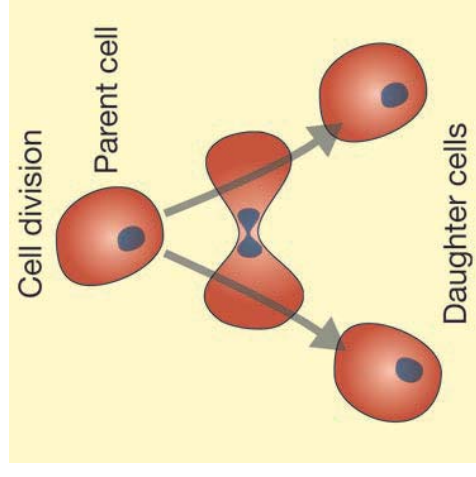


Figure 10.1: Most of the cells in your body reproduce by dividing into two daughter cells.



MY JOURNAL

Most organisms grow by producing more cells. Why couldn't an organism grow simply by allowing its cells to get larger and larger? Write your thoughts on this question in your notebook. You may wish to review earlier chapters before you answer.



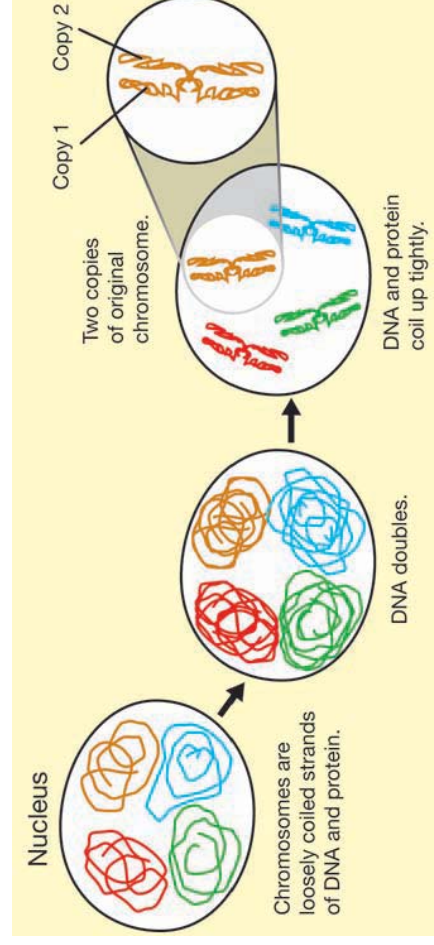
Chromosomes

What are chromosomes?

Eukaryotic cells are usually larger and more complex than prokaryotic cells. The DNA of a eukaryotic cell is found in the nucleus. That DNA is organized into structures called chromosomes. A **chromosome** is a structure made of DNA and protein in the nucleus of a eukaryotic cell. Chromosomes organize DNA into distinct units. Different organisms have different numbers of chromosomes. Humans for example, have 46 chromosomes. The proteins in a chromosome help support its structure and function. But the genetic information of the cell is stored in the DNA.

Chromosome doubling

Individual chromosomes are not clearly visible under a microscope until just before a cell begins to divide. Before cell division, chromosomes exist as long strands of DNA loosely coiled in the nucleus. Just before cell division begins, the amount of DNA doubles and so do the chromosomes. The DNA and protein in the doubled chromosomes coil up tightly. Each doubled chromosome consists of two copies of the original chromosome joined at the center.



VOCABULARY

chromosome - a structure made of DNA and protein in the nucleus of a eukaryotic cell.

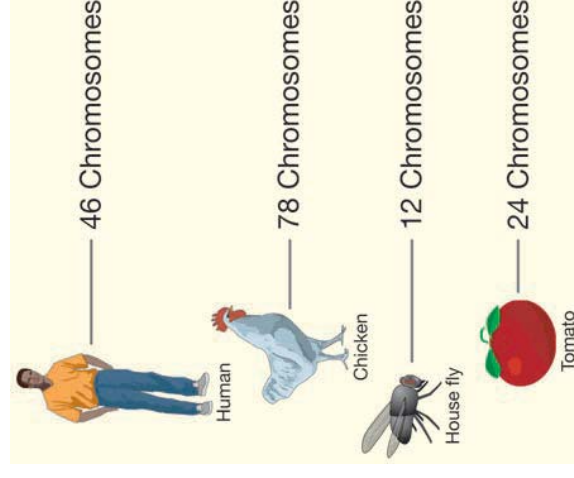


Figure 10.2: Different organisms have different numbers of chromosomes. Does the number of chromosomes have anything to do with the complexity of the organism?

The cell cycle

The life cycle of a cell

As you grow from an infant to an adult, you pass through different stages of your life cycle. Similarly, a cell passes through different stages of its life. The life cycle of a cell is called the cell cycle. The **cell cycle** is the period of time from the beginning of one cell division to the beginning of the next. It consists of three stages: interphase, mitosis, and cytokinesis (Figure 10.3).

Interphase

The longest stage of the cell cycle is called interphase.

Interphase is the stage that occurs in between cell divisions. During interphase the cell grows and develops and performs its functions. Toward the end of interphase (just before the cell begins to divide), the amount of DNA doubles. Organelles of the cytoplasm (like mitochondria) also double in number.

Mitosis

The second stage of the cell cycle is called mitosis. **Mitosis** is the process in cell division where the nucleus divides into two nuclei, each with an identical set of chromosomes. Mitosis is divided into four phases: *prophase*, *metaphase*, *anaphase*, and *telophase*. The illustration on the facing page shows what happens during each phase.

Cytokinesis

The shortest stage of the cell cycle is called cytokinesis. In **cytokinesis**, the cytoplasm and its organelles divide into two daughter cells. Each daughter cell contains a nucleus with an identical set of chromosomes. The two daughter cells then start their own cycles, beginning again with the interphase stage.

The cell cycle results in two daughter cells with identical sets of chromosomes.

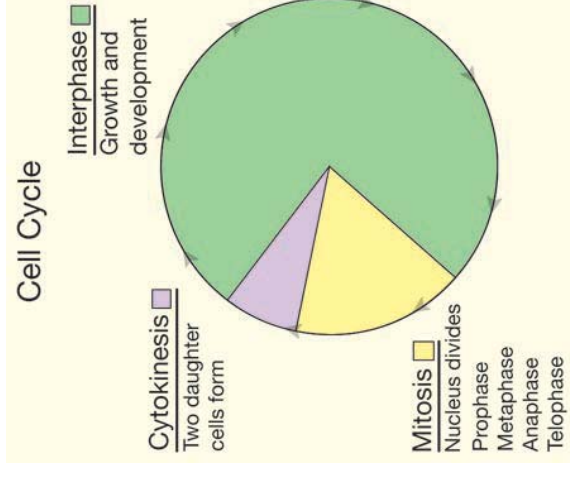


Figure 10.3: The cell cycle consists of three phases.



VOCABULARY

cell cycle - the period of time from the beginning of one cell division to the beginning of the next.

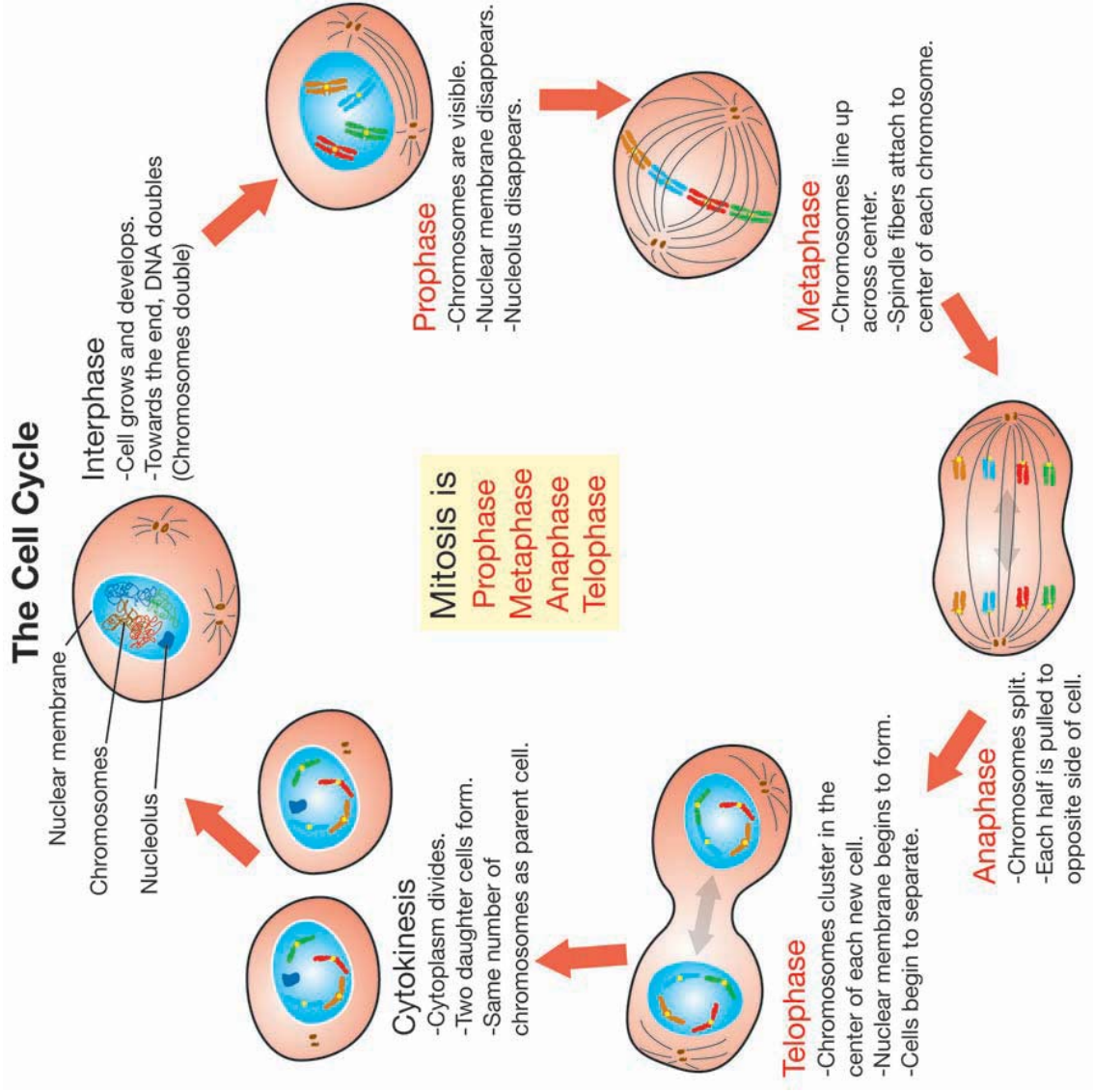
interphase - the stage of the cell cycle that occurs between cell divisions.

mitosis - the process of cell division where the nucleus divides into two nuclei.

cytokinesis - the process where the cytoplasm and its organelles divide into two daughter cells.

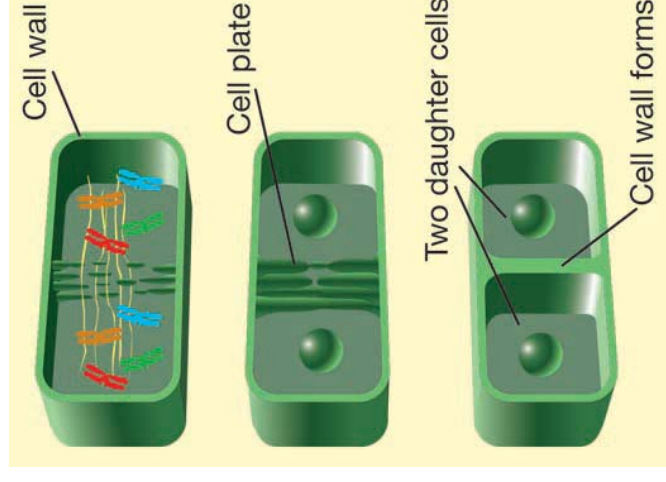


You have 46 chromosomes in your body cells. The diagram below shows the cell cycle in an organism with only 4 chromosomes.



Cytokinesis in plant cells

In plant cells, a cell plate forms between the two nuclei. The cell plate grows outward until a new cell wall separates the two cells as shown below.



Observing the cell cycle with a microscope

With a microscope and specially prepared slides, you can observe the cell cycle and identify each part. Figure 10.4 shows pictures of plant cells in each stage of the cell cycle.

Interphase

During most of interphase, the chromosomes are not visible. They appear as a grainy substance inside of the nucleus. Another way to identify interphase is to look for the nucleolus inside of the nucleus. The nucleolus disappears before mitosis begins.

Prophase

The first clue that mitosis has begun is the appearance of chromosomes. Because the amount of DNA has doubled, each chromosome appears as two identical strands joined at the center. Also, the nuclear membrane breaks down during this phase. You may also be able to see threads of protein called *spindle fibers*.

Metaphase

In metaphase, you can see the chromosomes lined up across the center of the cell. Each half is pointing in the opposite direction. The spindle fibers are attached to the center of each chromosome.

Anaphase

In anaphase, the chromosomes split. Each half is pulled toward the point where the spindle fibers come together. Anaphase is the phase of mitosis where the doubled chromosomes separate from each other.

Telophase

You can identify telophase by finding cells where the chromosomes are clustered at separate ends of the cell. The forming daughter cells begin to separate. A nuclear membrane forms around each cluster of chromosomes.

Cytokinesis

In cytokinesis, you can see that the cytoplasm is divided. Two separate daughter cells have formed, each with a complete set of chromosomes. Because it is so quick, this stage is hard to catch under a microscope.

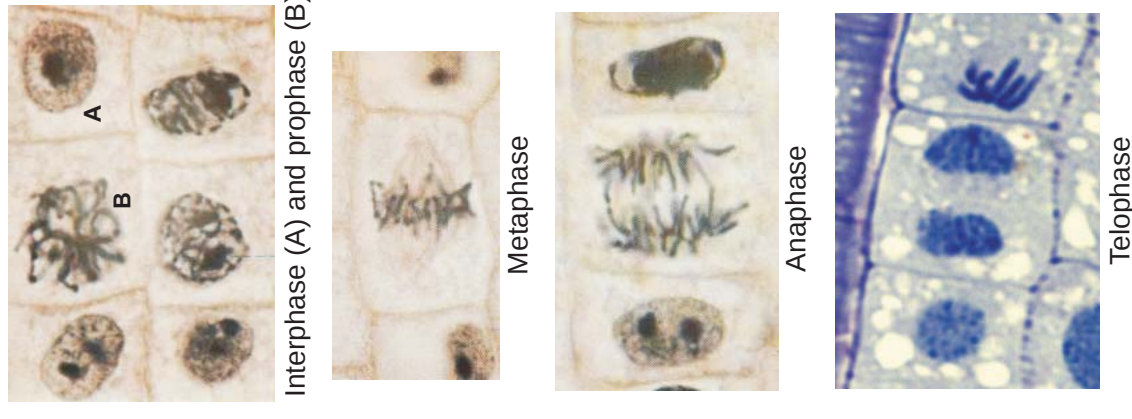


Figure 10.4: Photographs of plant cells in different stages of the cell cycle.